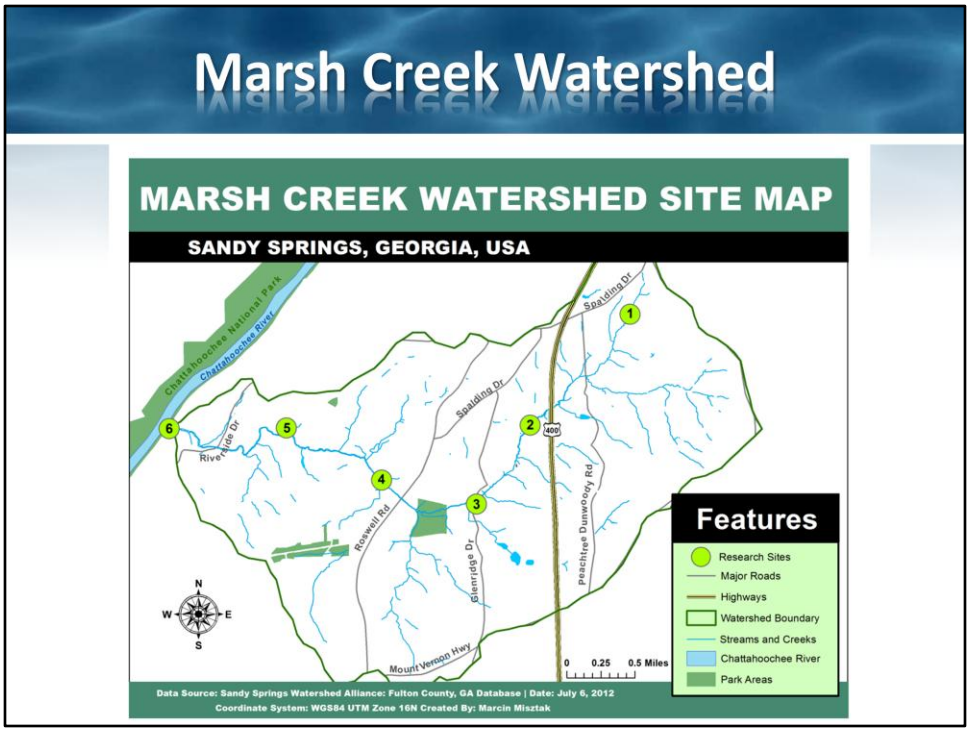
Bolling Hines

Introduction

- Big Question
  - Impact of Urbanization on Watershed Health
  - Increases in Non-Point Pollution Sources
- Area of Study
  - Marsh Creek Watershed
    - Six monitoring sites
    - One site per group
  - Long Island Creek Watershed
    - Twelve monitoring sites
    - Two sites per group

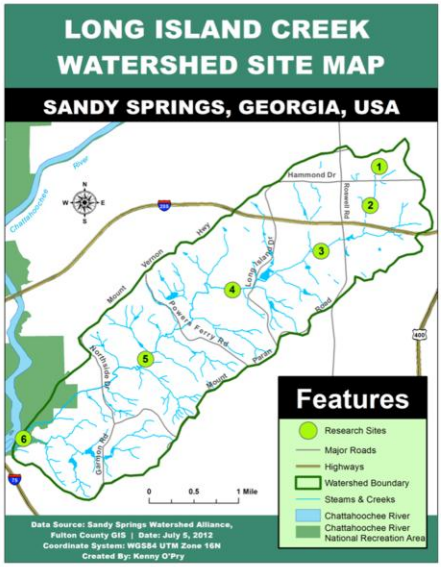
Bolling Hines

Marsh Creek Watershed



Bolling Hines

Long Island Creek Watershed



Bolling Hines

Marques Hayes

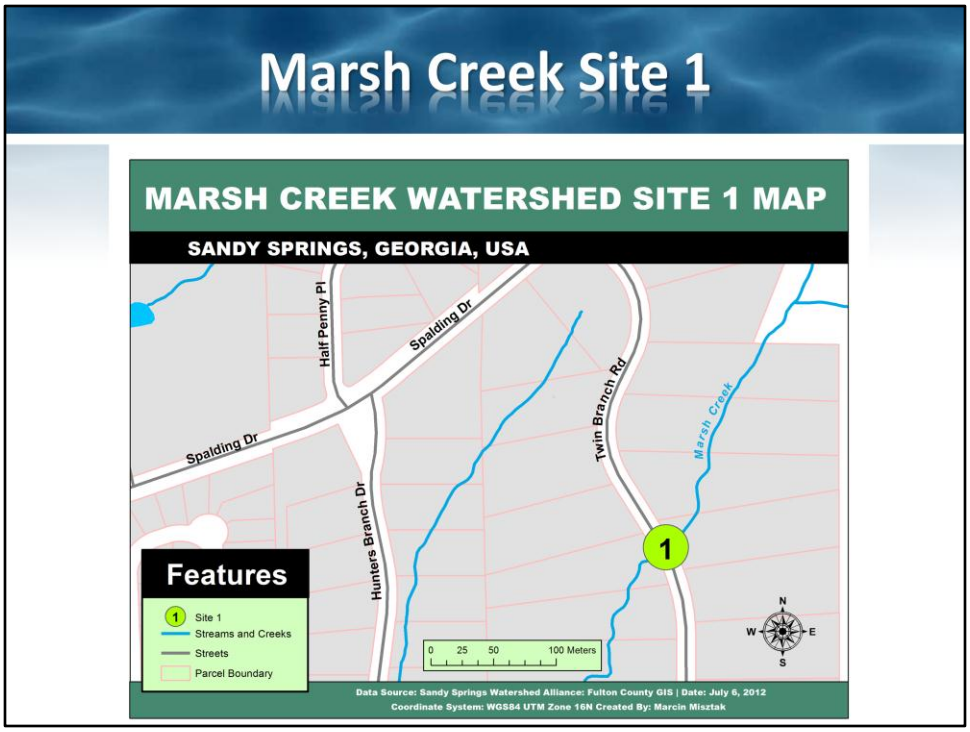
Stakeholders

National Park Service

KSU's Department of Biology & Physics

KSU's Department of Geography & Anthropology

Marques Hayes



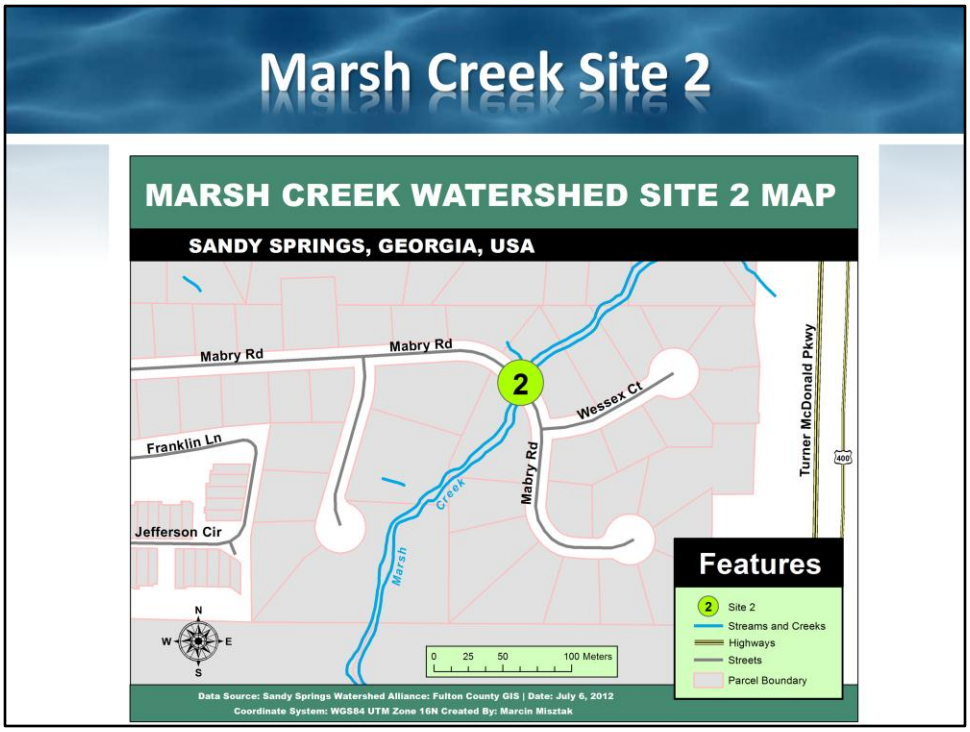
Daniel Harris

Daniel Harris

Marsh Creek Site 1 Concerns

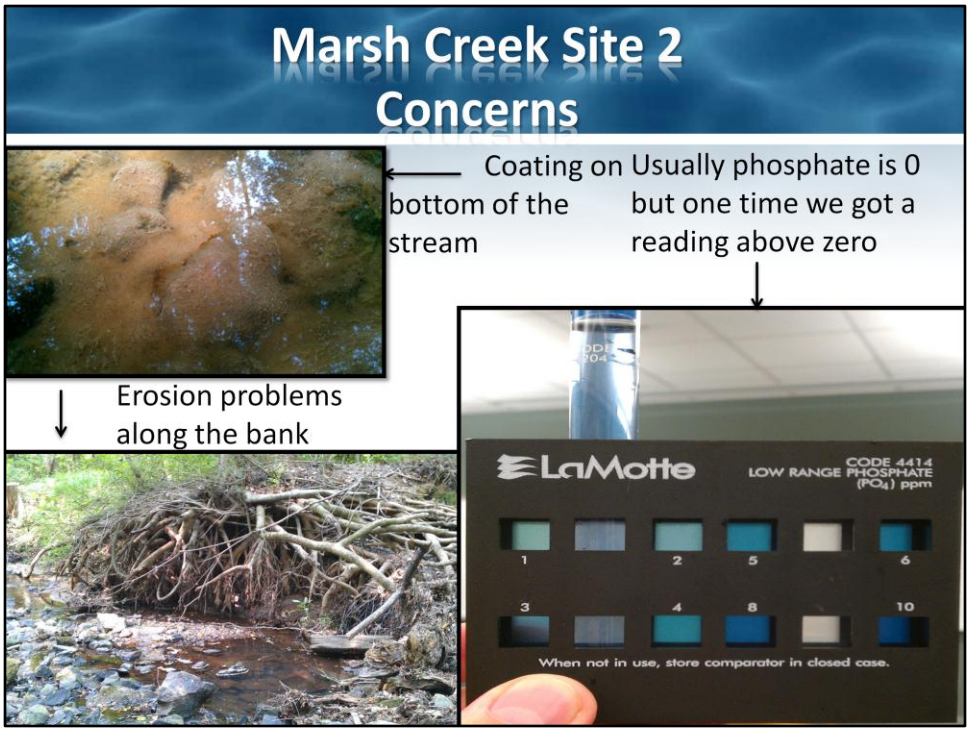
- Extreme Erosion Problems
- Water pollution
- Low consistent stream water levels
- Invasive plant species

Daniel Harris



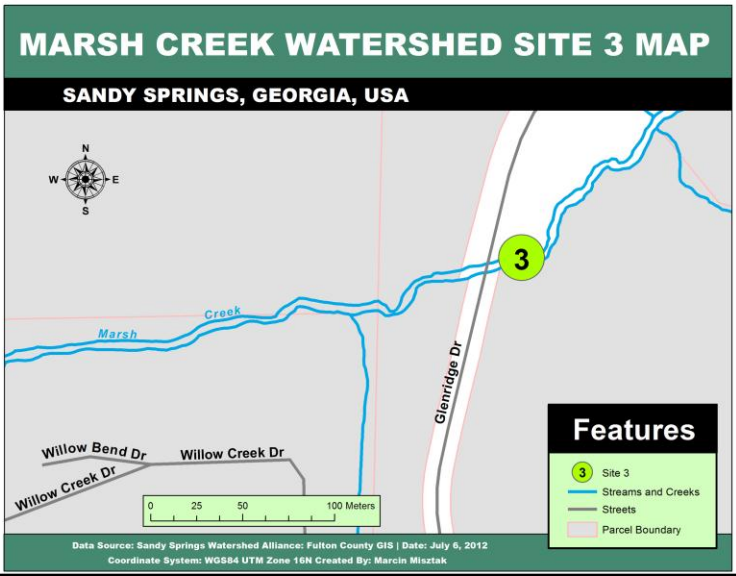
Samirra Madholm

Samirra Madholm



Samirra Madholm

Marsh Creek Site 3



Sara Tyson

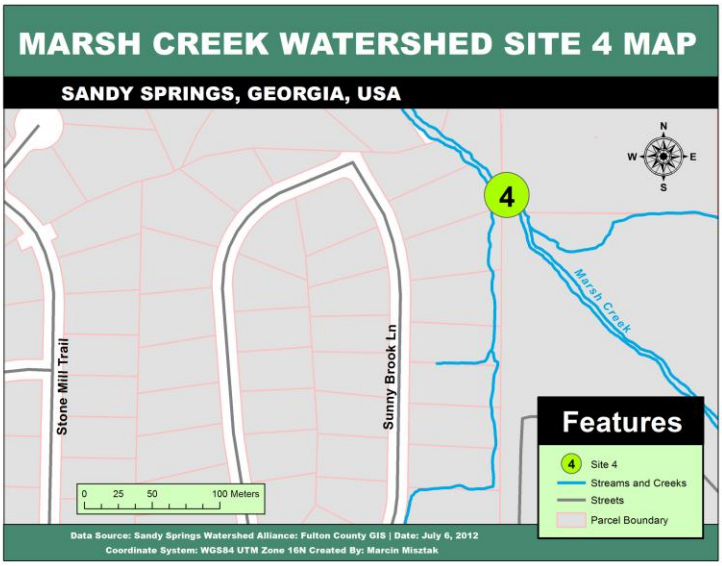
Sara Tyson

Marsh Creek Site 3 Concerns

- Unique due to its location on historic site
- Clear human presence
- Rusting culvert
- Evidence of undercutting and erosion

Sara Tyson

Marsh Creek Site 4



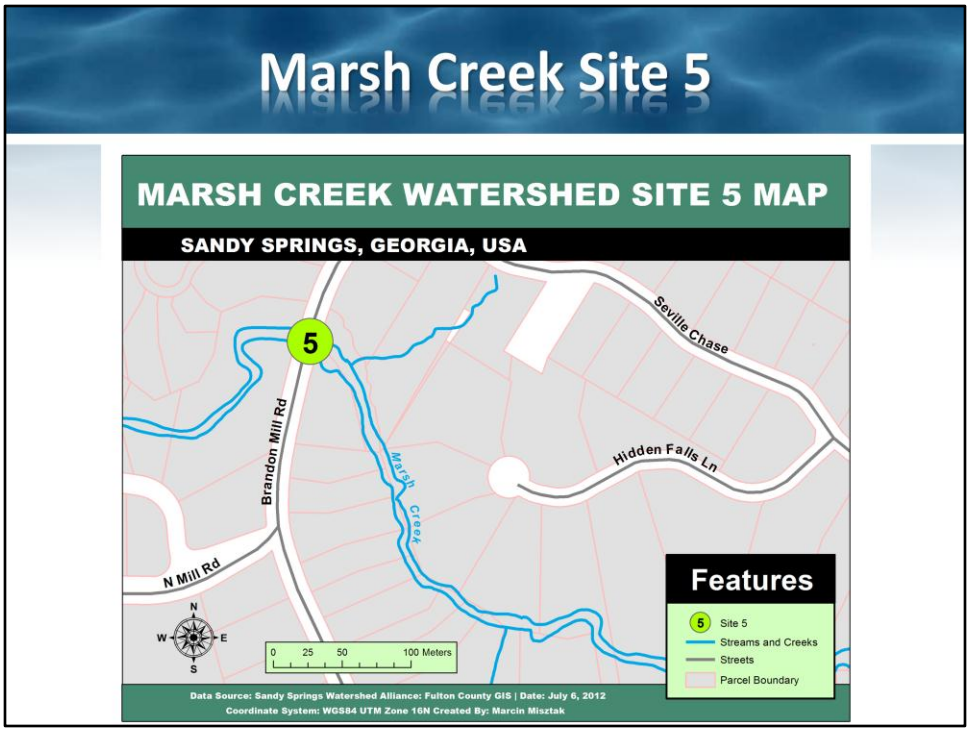
Alex Witherspoon

Alex Witherspoon

Marsh Creek Site 4 Concerns

- Bank erosion poses a threat to drainage structures, sewer pipes, trees, and most importantly stream ecology
- The result is several dredge spoils that have formed on the left bank exposing tree roots and disconnecting a headwall.
- Concrete retainer wall creating a channeling effect that is contributing to undercutting of the bank on the left side of the creek

Alex Witherspoon



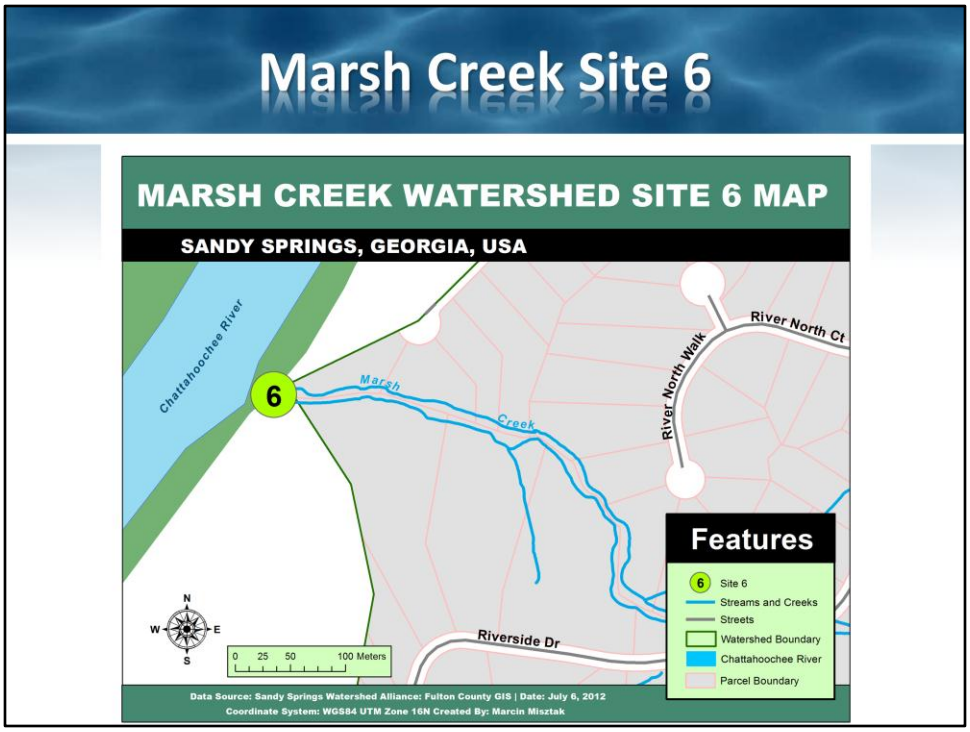
Monika Dominici

Monika Dominici

Marsh Creek Site 5 Concerns

- Proximity to residential development
- Proximity to bridge and road
- Eroded right bank (looking downstream) beginning to undercut trees and expose roots

Monika Dominici



Stephen Andrews

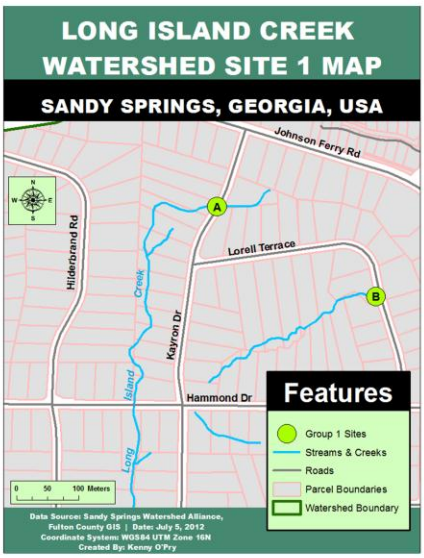
Stephen Andrews

Marsh Creek Site 6 Concerns

- High bacterial counts
- High turbidity
- Sewage Pipe over creek
- Debris in the creek

Stephen Andrews

Long Island Creek Site 1



Judy Morice

Judy Morice

Long Island Creek Site 1A Concerns

- Well established plantings
- Mature, successful erosion control
- Inconsistent water levels
- Embedded – fine silt

Judy Morice

Judy Morice

Long Island Creek Sites 1B Concerns

- Extreme Overgrowth of invasive shrubs
- Inconsistent stream water levels
- Obstructed stream channel
- Streamside Cover – no direct light

Judy Morice

Long Island Creek 2A

William “Shanks” Gavin

William “Shanks” Gavin

Long Island Creek 2A Concerns

- The erosion is continuing to undercut the banks
- The property owner next door has multiple dogs contributing more waste to the stream

William “Shanks” Gavin

William “Shanks” Gavin

Long Island Creek 2B Concerns

- Erosion is the greatest issue at this site
- The trees along the bank are suffering root problems, and starting to leaning over

William “Shanks” Gavin

Long Island Creek Site 3

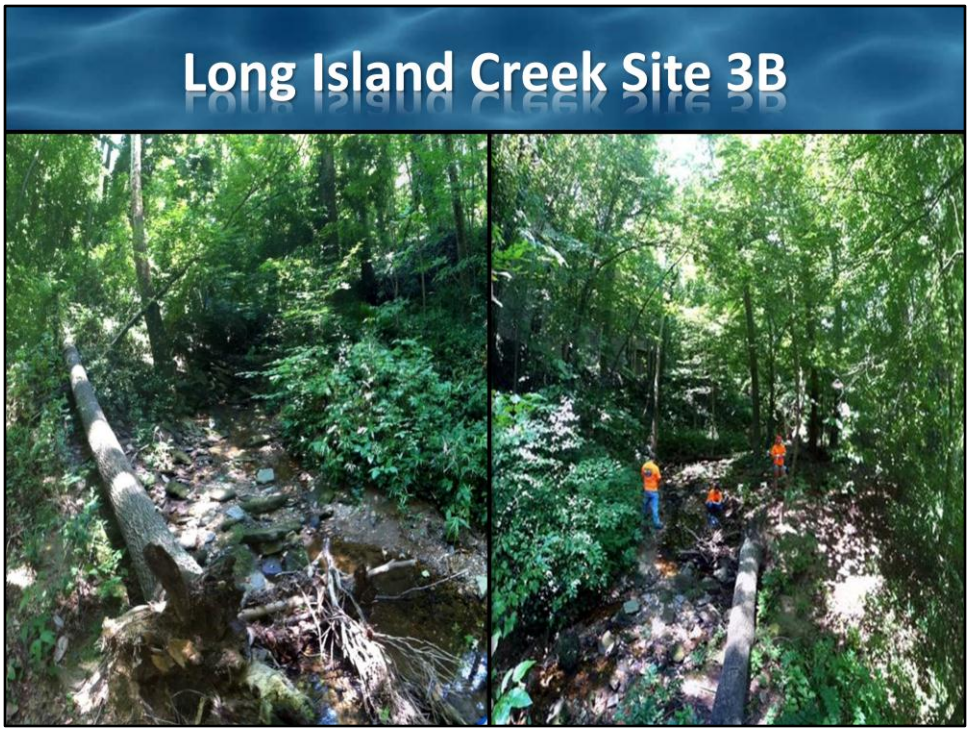
Anna Sharp

Anna Sharp

Long Island Creek Site 3A Concerns

- Heavy debris, clear evidence of human presence
- Bridge impacts watershed
- Falling trees due to erosion/undercutting

Anna Sharp



Anna Sharp

Long Island Creek Site 3B Concerns

- Runoff and litter from apartment complex
- Water level low
- In a developing area

Anna Sharp

Long Island Creek Site 4

Jessica Wilson

Jessica Wilson

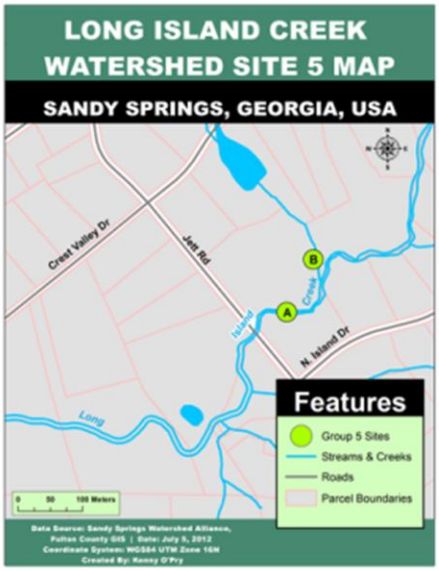
Jessica Wilson

Long Island Creek Site 4 Concerns

- Sedimentation creating shelves of sand and gravel along left bank
- Yard waste poses threat to stream ecology
- Some erosion but not an immediate threat

Jessica Wilson

Long Island Creek Site 5



Monika Dominici

Monika Dominici

Monika Dominici

Long Island Creek Site 5 Concerns

- Sewage Pipe upstream of Site B
- Fish kills discovered on last day of monitoring
- Left bank erosion (looking downstream) undercutting trees and exposing roots
- Completing gaps in right bank restoration project

Monika Dominici

Long Island Creek Site 6

Craig Brady

Craig Brady

Long Island Creek Sites 6A Concerns

- Impact of pipe upstream outside reach
- Undercutting soil erosion
- Large amount of debris in stream

Craig Brady

Craig Brady

Long Island Creek Site 6B Concerns

- Foot bridge
- Large tree in stream
- Major amounts of debris in stream

Craig Brady

Water Quality

Why is water quality an important factor?

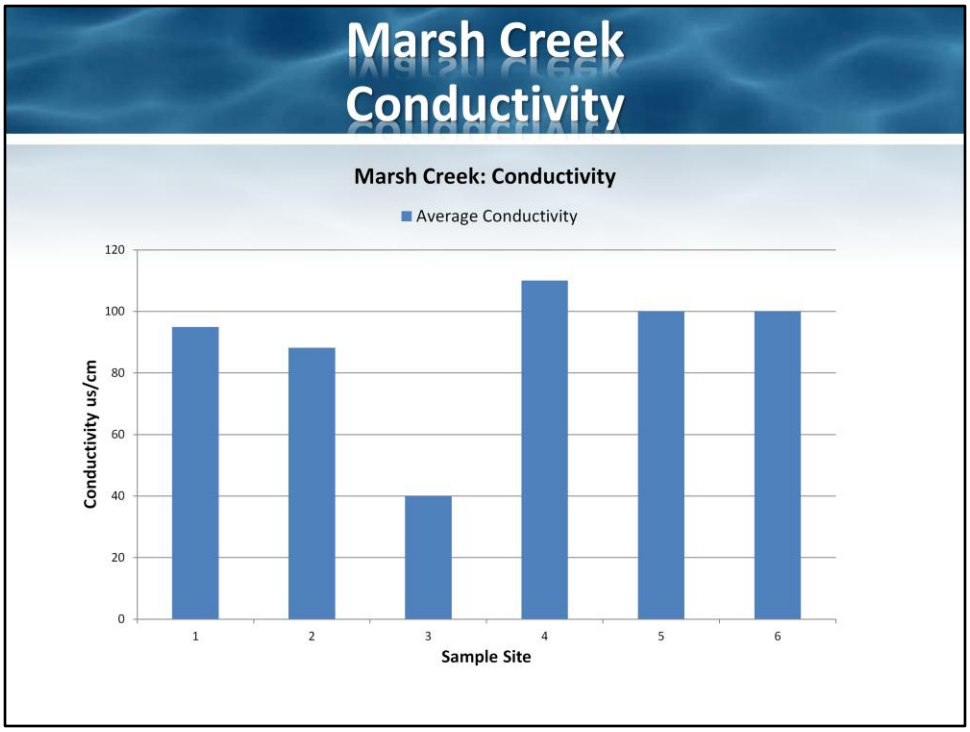
- The success of human existence depends on our need for clean drinking water.
- In order to ascertain the chemical and bacterial parameters of Marsh Creek and Long Island Creek.
- It is important to document water pollution so that remediation may be executed and prevention measures can be put in place.

Eric Duncan

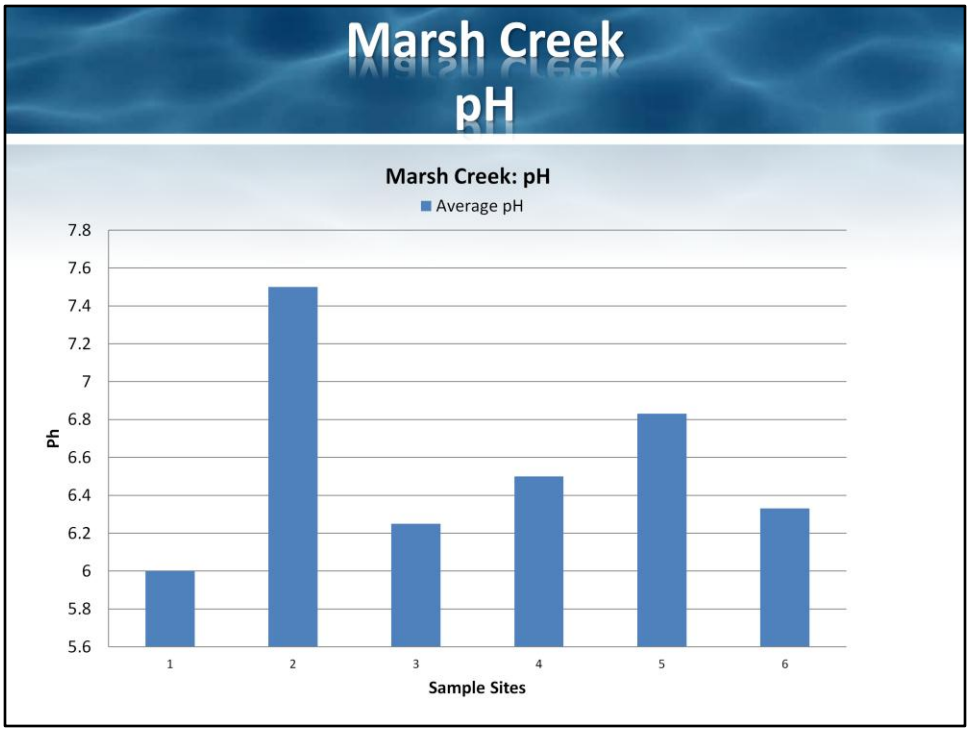
Water Quality Methods

- Georgia Adopt-A-Stream (AAS) standards
- Mid-stream, mid-depth taken three separate dates
- Sterile collection
- Upstream sampling
- If no water was available then “No Data” (N/D) was noted.

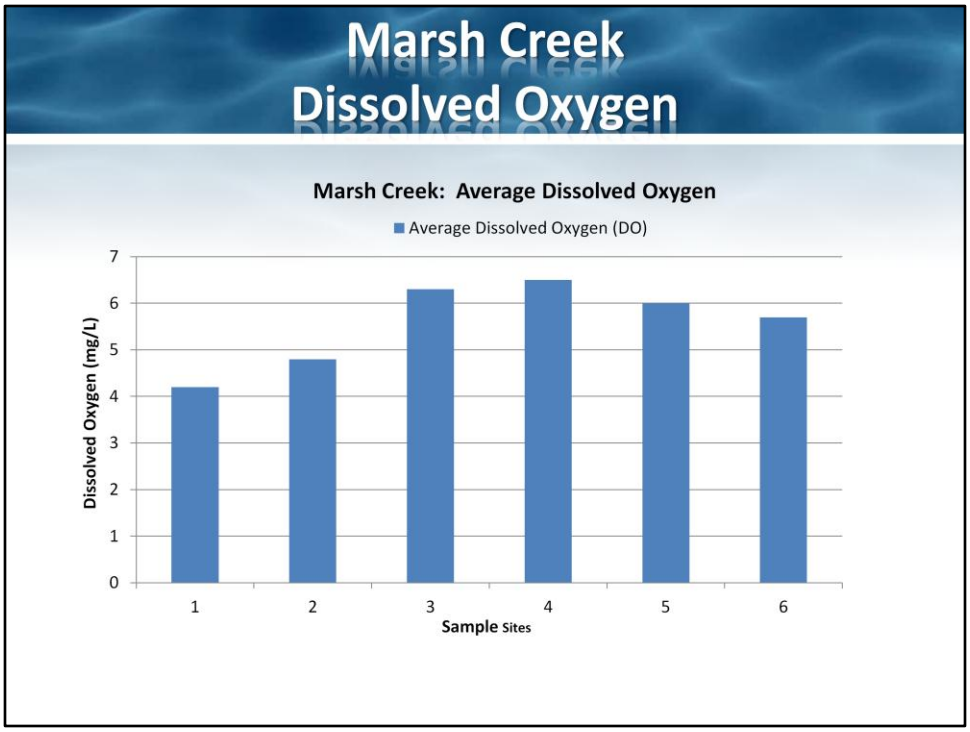
Eric Duncan


Marsh Creek Conductivity
Marsh Creek: Conductivity
Average Conductivity
Conductivity us/cm
120
100
80
60
40
20
0
1
2
3
4
5
6
Sample Site

Sean Bagby

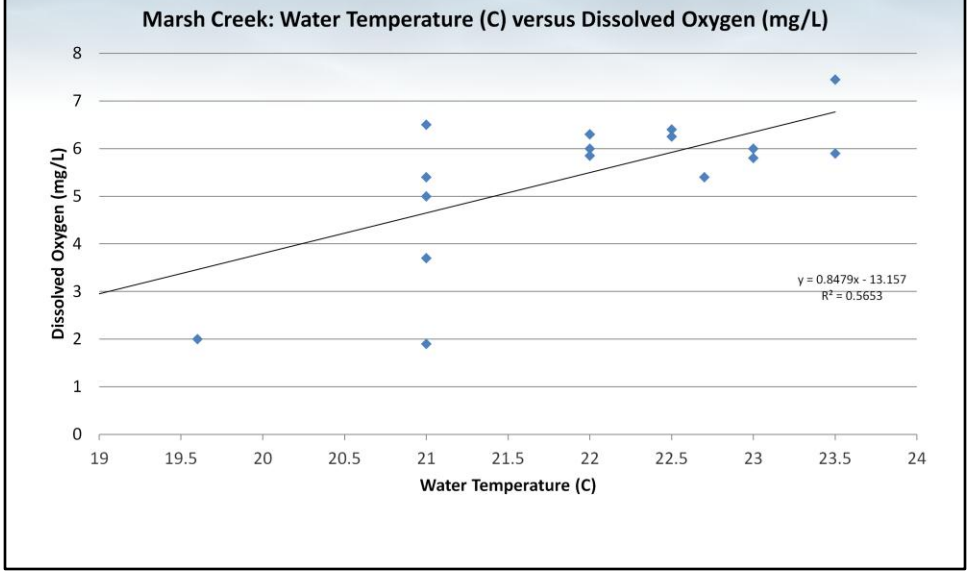

Marsh Creek
pH
Marsh Creek: pH
Average pH
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
Ph
1
2
3
4
5
6
Sample Sites

Sean Bagby


Marsh Creek
Dissolved Oxygen
Marsh Creek: Average Dissolved Oxygen
Average Dissolved Oxygen (DO)
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
Sample Sites

Sean Bagby

Marsh Creek
Water Temp vs. Dissolved Oxygen



Sean Bagby

Marsh Creek
Nitrate-nitrogen/Phosphate

	Nitrate (mg/L)			Phosphate (mg/L)		
Sites	Max	Min	Average	Max	Min	Average
1	0	0	0	0	0	0
2	0	0	0	2.5	2	2.25
3	0	0	0	0	0	0
4*	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0

*n= 8 collected over 4 days; all others are n= 6 collected over 3 days

Sean Bagby

Marsh Creek
E. coli & Coliform

E. Coli (cfu/100ml)

Date	E. Coli: MC 1	E. Coli: MC 2	E. Coli: MC 3	E. Coli: MC 4	E. Coli: MC 5	E. Coli: MC 6
6/14/12	2200	--------	500	0	0	TNTC
6/21/12	1433	1833	200	0	233	533
6/28/12	----------	400	300	0	100	667

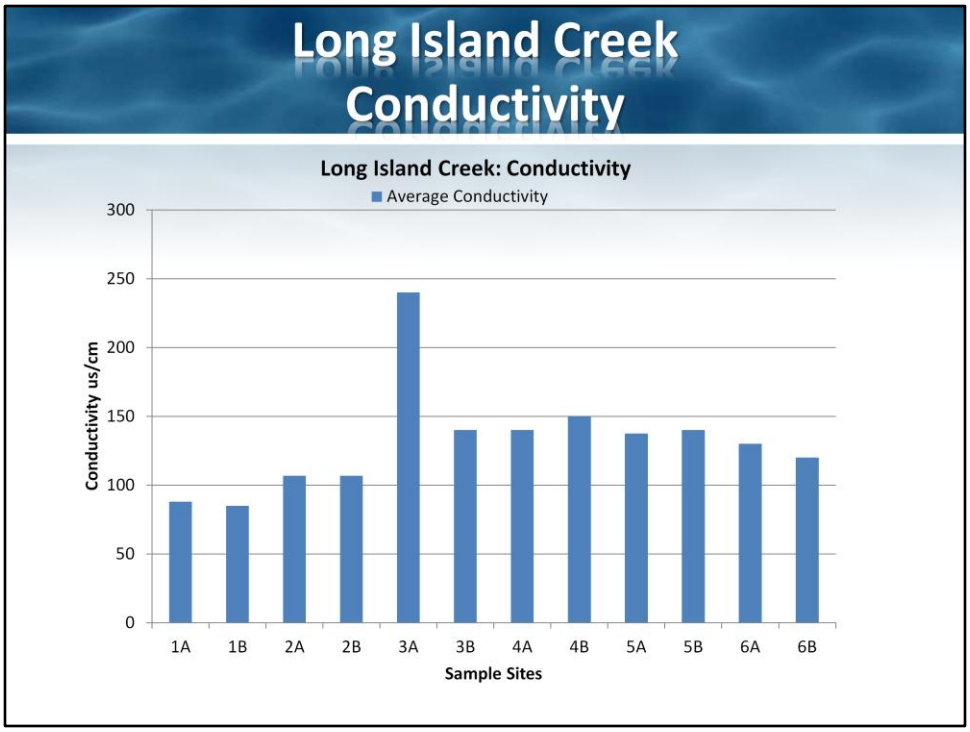
n=3
TNTC= too numerous to count
---------- = information unavailable

Coliform

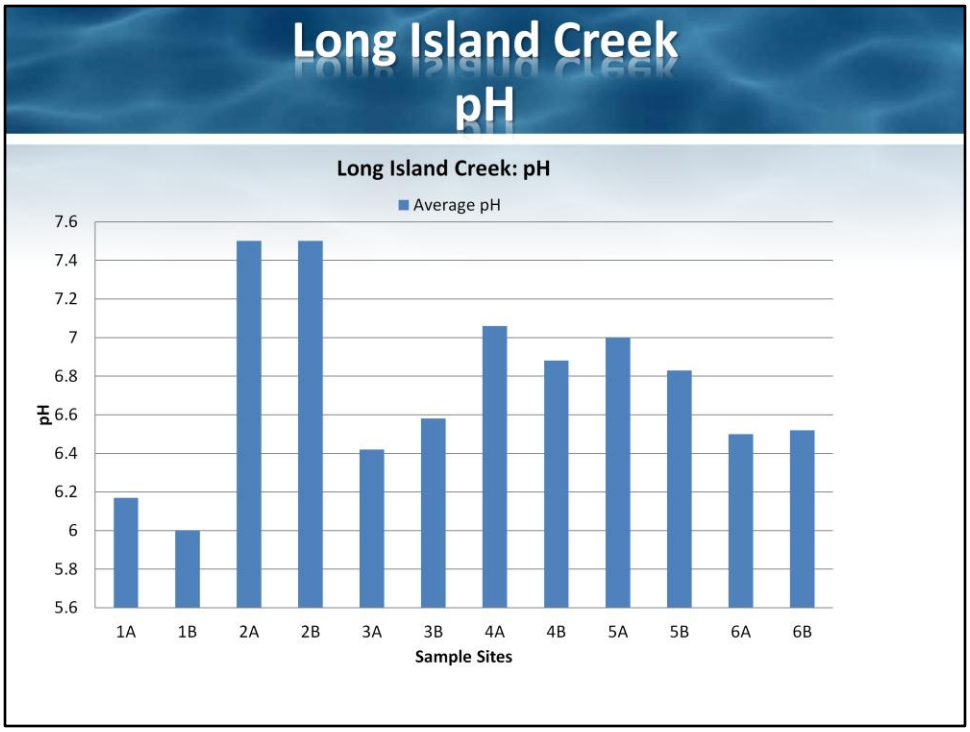
Date	Coliform: MC 1	Coliform: MC 2	Coliform: MC 3	Coliform: * MC 3	Coliform: MC 4	Coliform: MC 5	Coliform: MC 6
6/14/12	3	----------	----------	----------	2	TNTC	TNTC
6/14/12	3	----------	----------	----------	2	2	2
6/28/12	----------	2	1	2	2	1	2

n=3
1= none 2= <50% of plate 3= >50% of plate
TNTC= too numerous to count
--------- = information unavailable

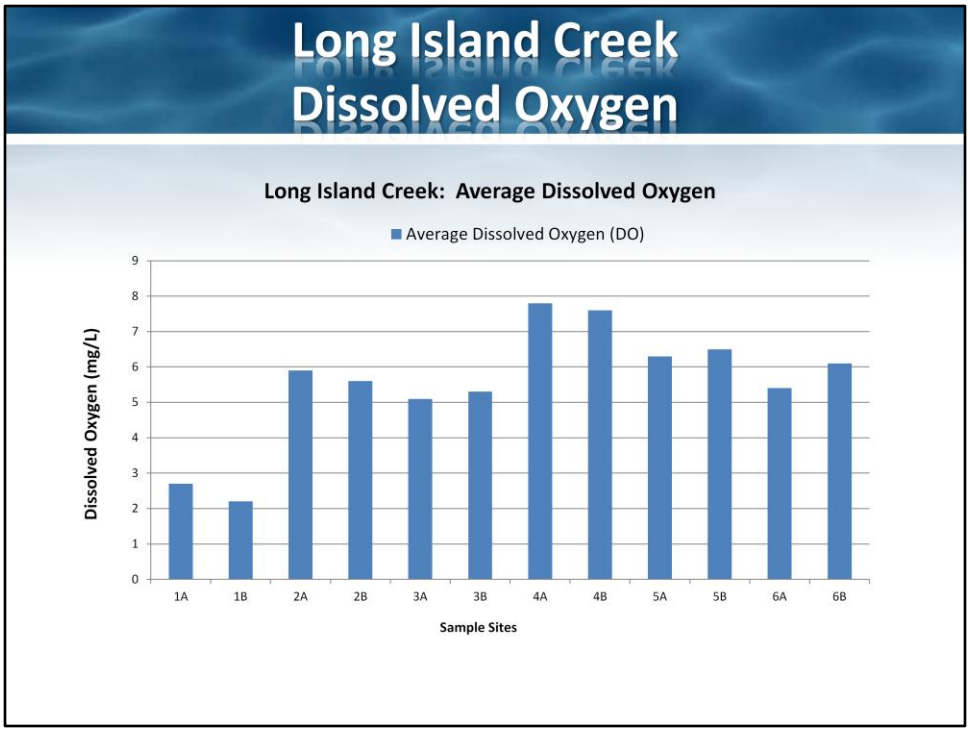
Sean Bagby


Long Island Creek
Conductivity
Long Island Creek: Conductivity
Average Conductivity
Conductivity us/cm
300
250
200
150
100
50
0
1A
1B
2A
2B
3A
3B
4A
4B
5A
5B
6A
6B
Sample Sites

Sean Bagby

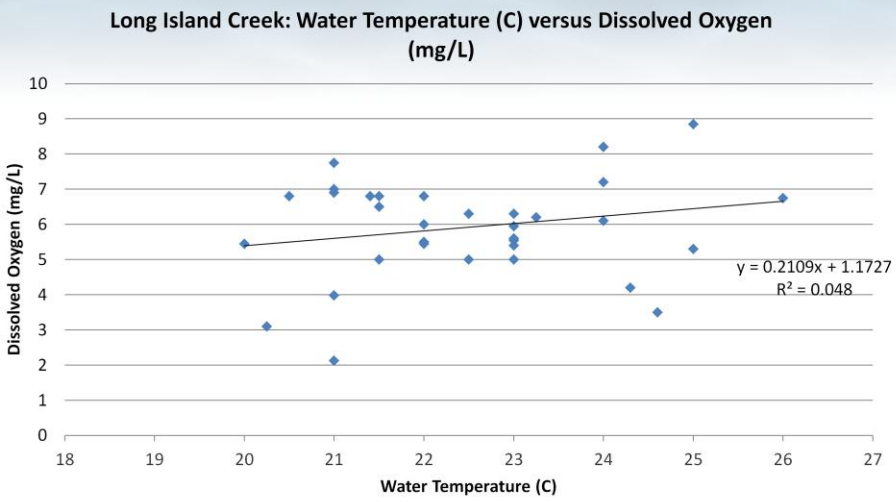

Long Island Creek
pH
Long Island Creek: pH
Average pH
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
pH
1A
1B
2A
2B
3A
3B
4A
4B
5A
5B
6A
6B
Sample Sites

Sean Bagby


Long Island Creek
Dissolved Oxygen
Long Island Creek: Average Dissolved Oxygen
Average Dissolved Oxygen (DO)
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
9
1A
1B
2A
2B
3A
3B
4A
4B
5A
5B
6A
6B
Sample Sites

Sean Bagby

Long Island Creek
Water Temperature vs. Dissolved Oxygen



Sean Bagby

Long Island Creek Nitrates/Phosphates

	Nitrate (mg/L)			Phosphate (mg/L)		
Sites*	Max	Min	Average	Max	Min	Average
1A	0	0	0	0	0	0
1B	0	0	0	0	0	0
2A	1	0	<1	0	0	0
2B	0	0	0	0	0	0
3A	0	0	0	0	0	0
3B	0	0	0	0	0	0
4A*	0	0	0	0	0	0
4B*	0	0	0	0	0	0
5A	0	0	0	0	0	0
5B	0	0	0	0	0	0
6A	0	0	0	0	0	0
6B	0	0	0	0	0	0

*n= 8 samples collected over 4 days; all others are n= 6 collected over 3 days

Sean Bagby

Long Island Creek
E. coli and Coliform

E. Coli (cfu/ml)

Date	LI 1A	LI 1B	LI 2A	LI 2B	LI 3A	LI 3B	LI 4A	LI 4B	LI 5A	LI 5B	LI 6A	LI 6B
6/12/12	1433	1533	1100	1000	3500	600	0	0	1100	1267	1467	1000
6/19/12	1167	1133	933	533	1633	267	0	0	300	300	700	667
6/26/12	--------	533	1500	1300	733	67	0	0	367	533	267	700

n=3
TNTC= too numerous to count

Coliform

Date	LI 1A	LI 1B	LI 2A	LI 2B	LI 3A	LI 3B	LI 4A	LI 4B	LI 5A	LI 5B	LI 6A	LI 6B
6/14/12	3	3	-------	--------	3	--------	2	2	3	3	2	2
6/21/12	3	3	-------	--------	--------	--------	2	2	2	2	2	2
6/28/12	--------	2	3	2	2	2	2	2	2	2	2	2

n=3
1= none 2= <50% of plate 3= >50% of plate
TNTC= too numerous to count
-------- = information unavailable

Sean Bagby

Urban Ecology

- Urban Areas risks are generally higher than Rural Areas:
  - Increased Tree Risks
  - Invasive, Exotic Species
  - Less Diversity of Species
  - Chlorophyll Levels indicate algae communities

Richard Hullender

Urban Ecology Methods

- United States Department of Agriculture (USDA) Community Tree Risk Evaluation Form
- Diameter at Breast Height (DBH)
- Percent of area affected deviated from USDA standards to:
  - 20%-30% = 1
  - 30%-40% = 2
  - 50% = 3

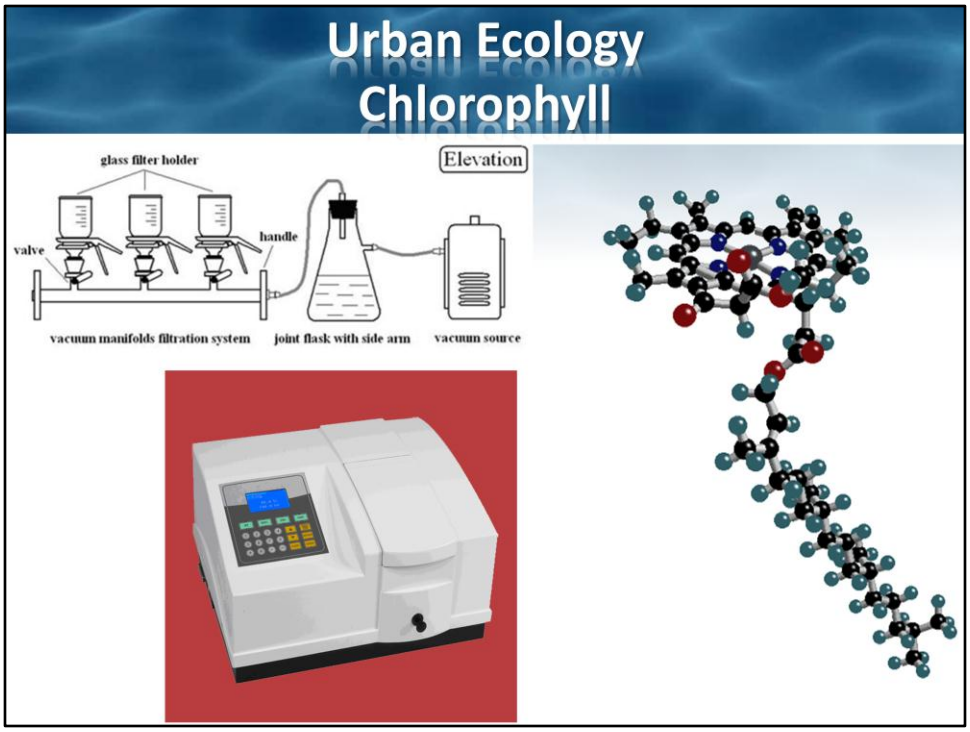
Eric Harvey

Urban Ecology

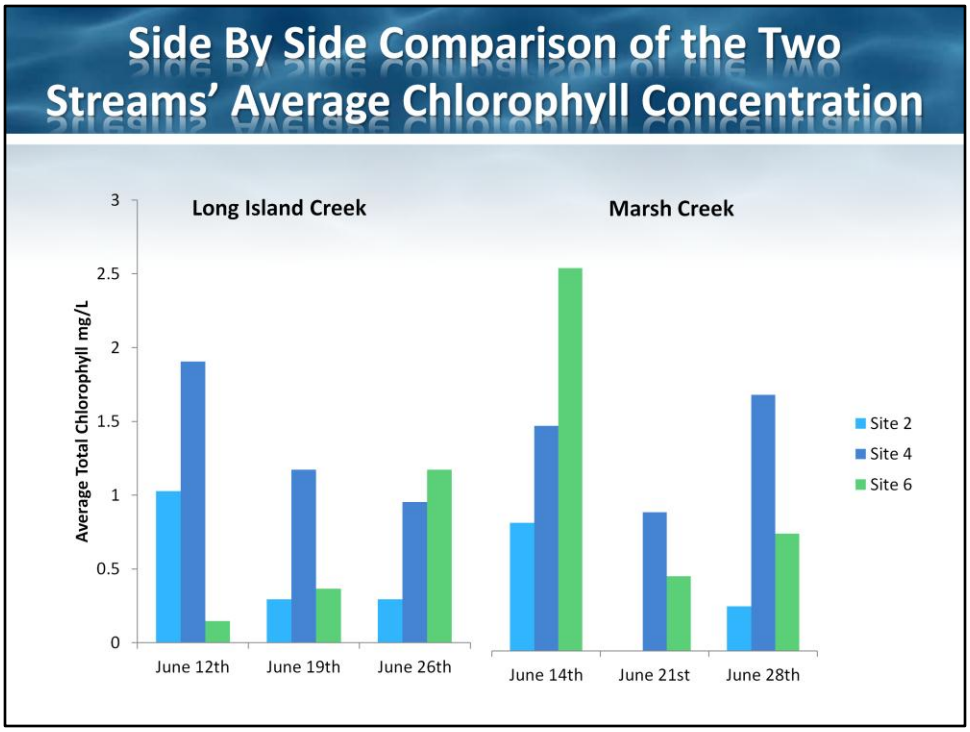
Mean Tree Risk Assessment Values

Marsh Creek		Long Island	
Site	Risk Rating	Site	Risk Rating
1	3.25	1	3.72
2	4.85	2	4.63
3	5.89	3	5.6
4	5.6	4	5.8
5	3.81	5	3.4
6	3.15	6	4.1

Eric Duncan


Urban Ecology
Chlorophyll
glass filter holder
Elevation
valve
handle
vacuum manifolds filtration system
joint flask with side arm
vacuum source

Eric Duncan


Side By Side Comparison of the Two Streams' Average Chlorophyll Concentration
Long Island Creek
Marsh Creek
Average Total Chlorophyll mg/L
3
2.5
2
1.5
1
0.5
0
June 12th
June 19th
June 26th
June 14th
June 21st
June 28th
Site 2
Site 4
Site 6

Eric Duncan

Jessica Wilson

Index of Biotic Integrity

Summary of IBI of the Long Island Creek stretch sampled on Jun 21, 2012

IBI Metrics	LI 2011: Metric Score (1, 3 or 5)	LI 2012: Raw Score	LI 2012: Metric Score (1, 3, or 5)
Number of Native Species	3	10	3
Number of Benthic Invertivore Species	1	0	1
Number of Native Sunfish Species	3	2	3
Native Insectivorous Cyprinid Species	1	1	1
Head Water Intolerance	1	2	3
Round Bodied Sucker Species	1	1	1
Species Eveness	5	86.8	5
Percent of Fish as Lepomis Species	5	22.2%	5
Percent of Fish as Insectivorous Cyprinids	1	6.2%	1
Percent of Fish as Generalists or Herbivores	3	38/3%	3
Percent of Fish as Benthic Fluvial Specialist	1	30.9%	3
Percent of Individuals per 200 m of stream	1	216	1
DELT Anomalies	0	0	0
Overall IBI score (range 8-60)	26	----------	30
IBI narrative rank (very poor, poor, fair, good, excellent)	poor	----------	poor

IBI results yielded a higher score than the previous year's sampling. A total score of 30 was obtained inferring that the overall health of the stream is still poor.

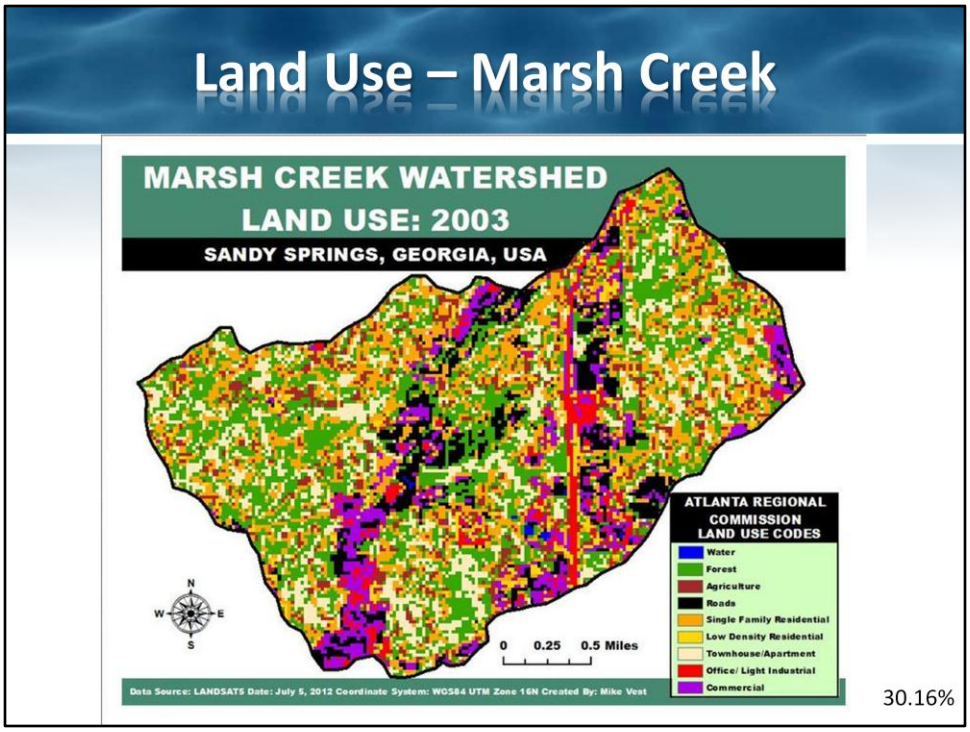
Jessica Wilson

Land Use

- Remote Sensing was utilized to map land use
  - Remote sensing uses instruments mounted on satellites to produce images that displayed watershed for each site.
  - This information was formulated with impervious quotient as set forth by the Atlanta Regional Commission and Adopt-a-Stream.
  - We compared this spatial information over a period 8 years in 6 intervals (2003, 2005, 2006, 2008, 2009 2011)

Jeffrey Oparnica

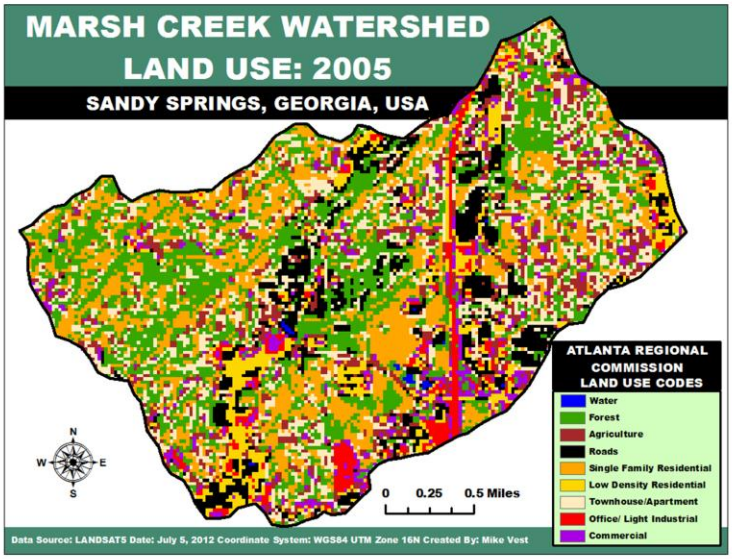
Land Use – Marsh Creek



30.16%

Jeffrey Oparnica

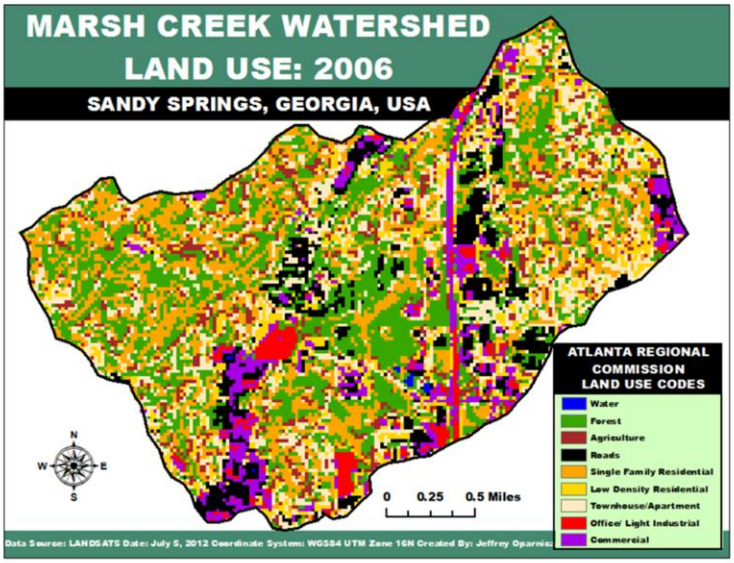
Land Use – Marsh Creek



29.28%

Jeffrey Oparnica

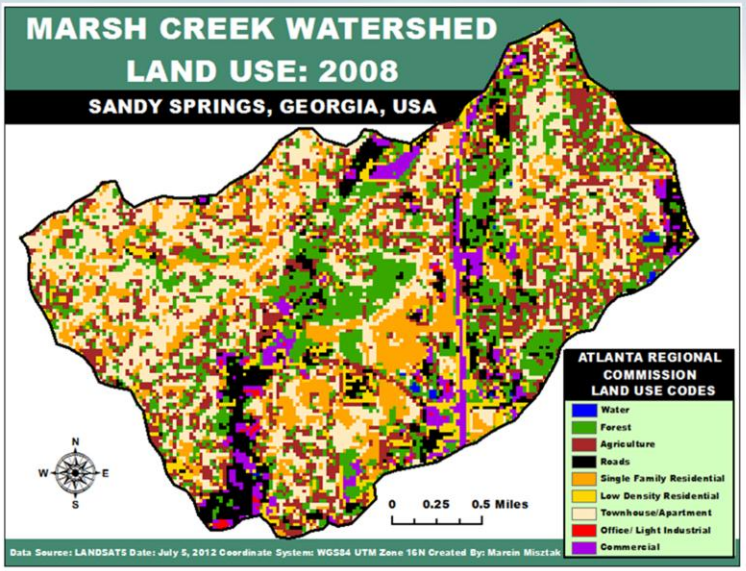
Land Use – Marsh Creek



30.03%

Jeffrey Oparnica

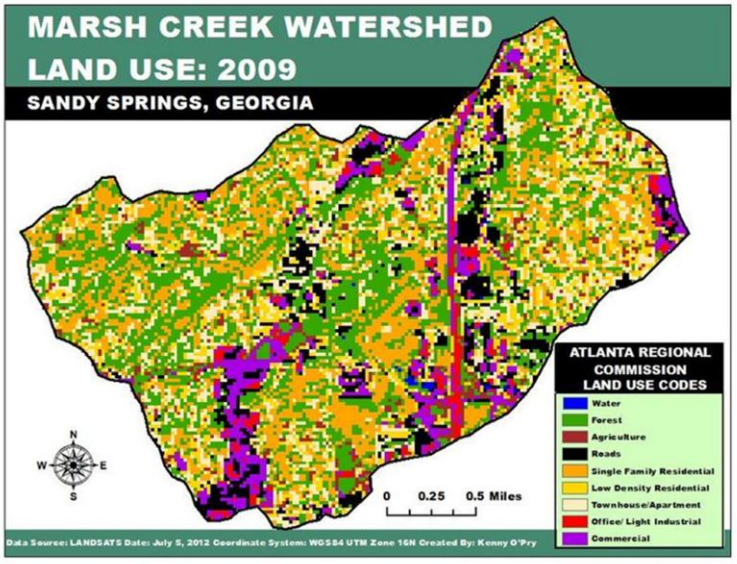
Land Use – Marsh Creek



27.31%

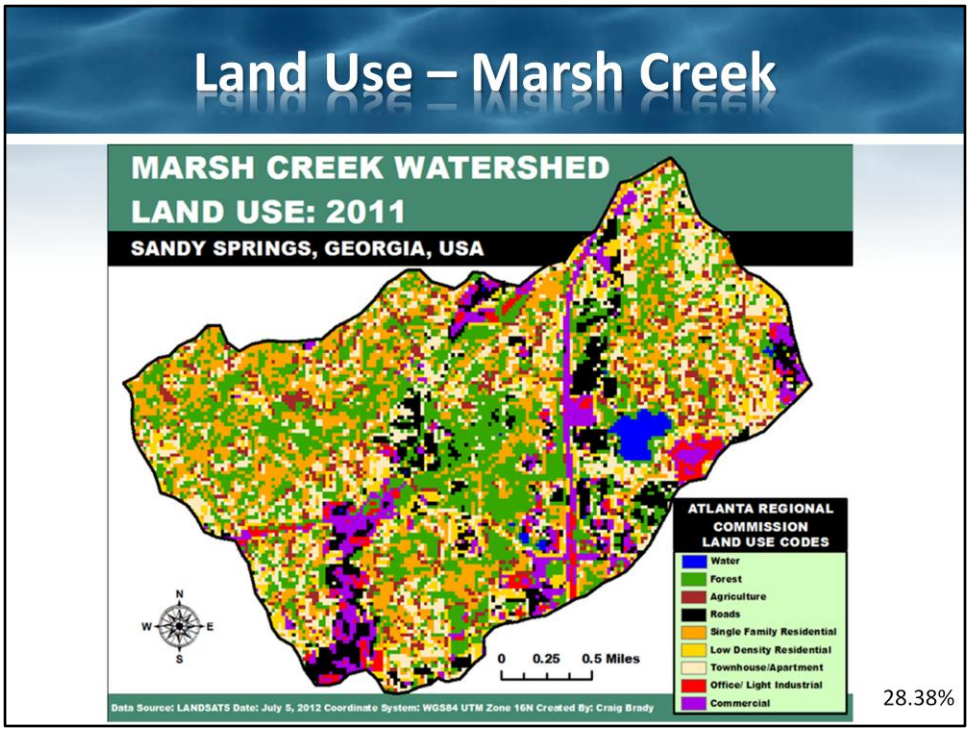
Jeffrey Oparnica

Land Use – Marsh Creek



34.10%

Jeffrey Oparnica



Jeffrey Oparnica

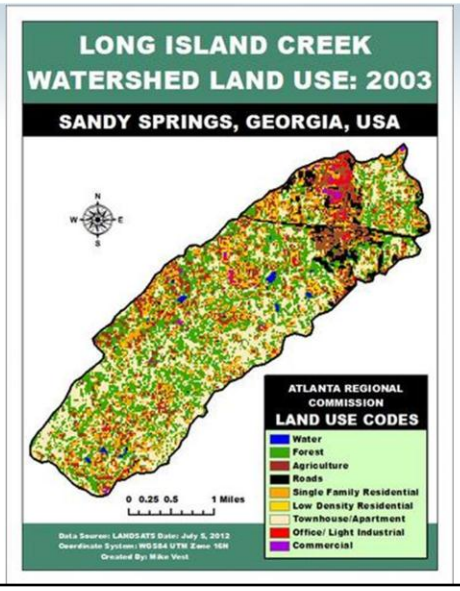
Marsh Creek - Impervious Surfaces

Percent % of impervious surface in Marsh Creek Watershed (as based on ARC impervious quotients)

	Classes								TOTAL
Year	Major Roads	Commercial	Forest	Low Density Residential	Apartment/ Townhouse	Single Family Residential	Agriculture	Office/ Light Industrial	% impervious surface in watershed
2003	7.81	6.61	0.13	1.06	7.5	4.40	0.05	2.6	30.16
2005	8.66	3.76	0.12	1.67	8.7	3.81	0.06	2.5	29.28
2006	7.87	5.5	0.13	2.37	8.33	3.94	0.04	2.12	30.3
2008	6.93	3.74	0.10	1.72	11.75	2.74	0.09	0.24	27.31
2009	9.36	11.31	0.10	1.8	3.7	1.43	0.03	6.37	34.1
2011	7.47	5.97	0.13	2.33	6.77	3.87	0.04	1.8	28.38

Sean Bagby

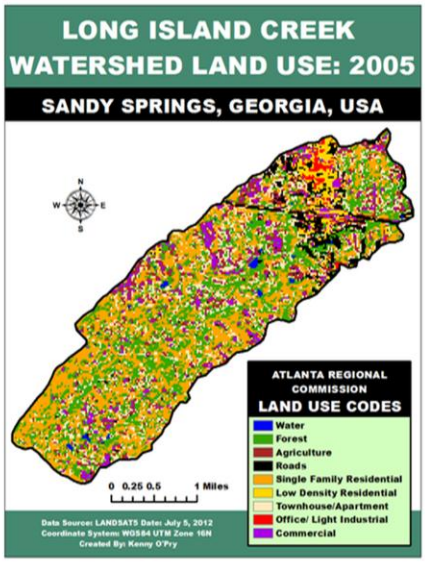
Land Use – Long Island Creek



26.47%

Jeffrey Oparnica

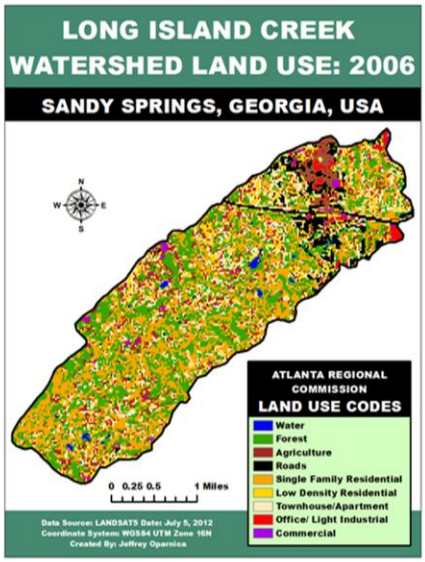
Land Use – Long Island Creek



24.04%

Jeffrey Oparnica

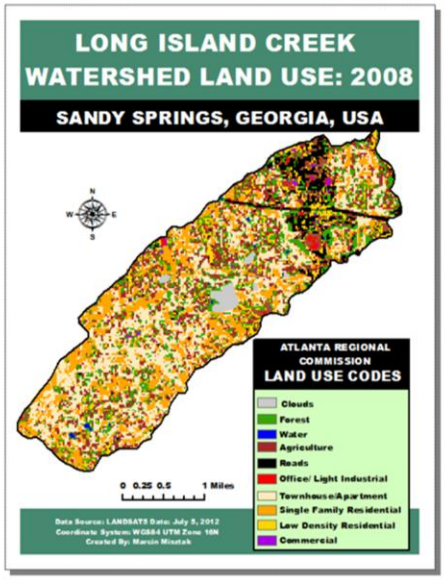
Land Use – Long Island Creek



22.97%

Jeffrey Oparnica

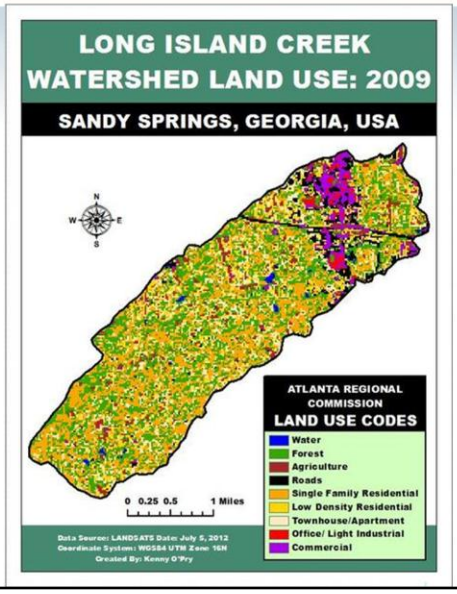
Land Use – Long Island Creek



27.19%

Jeffrey Oparnica

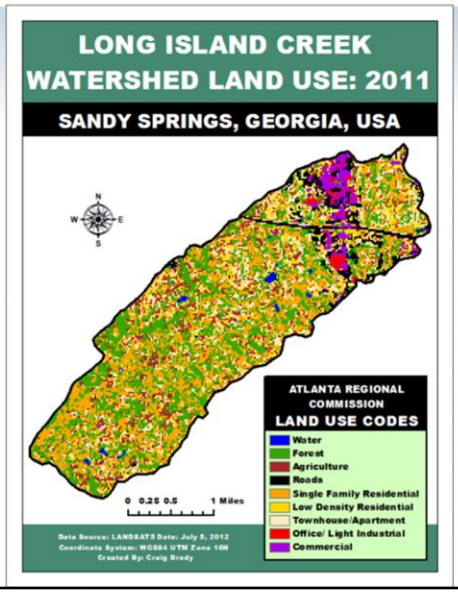
Land Use – Long Island Creek



36.20%

Jeffrey Oparnica

Land Use – Long Island Creek



22.70%

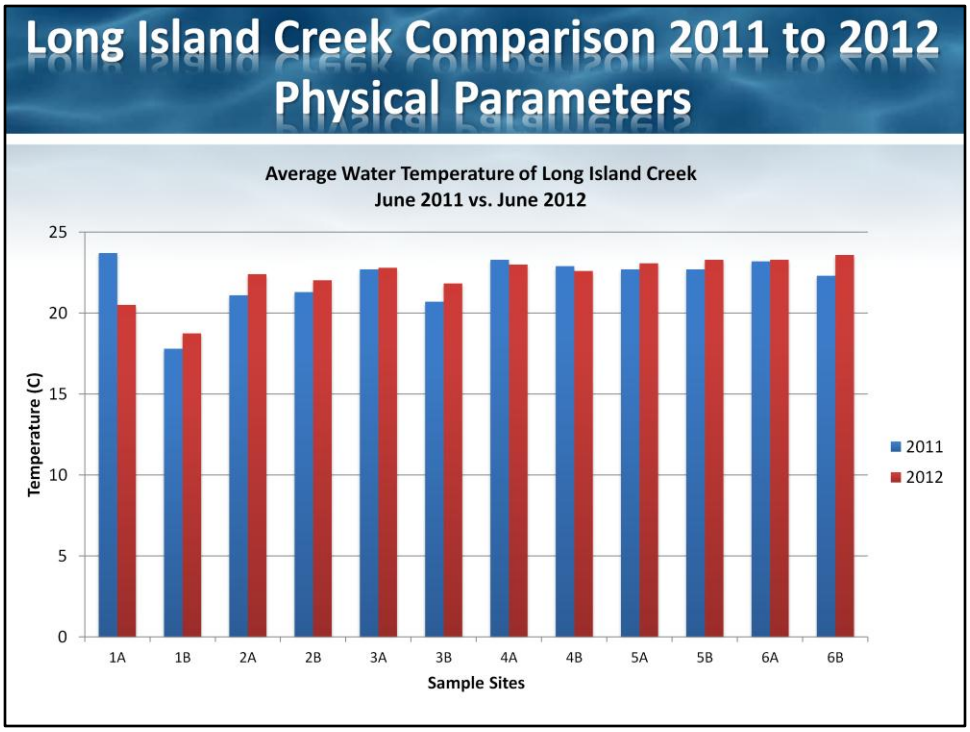
Jeffrey Oparnica

Long Island Creek Impervious Surfaces

Percent % of impervious surface in Long Island Creek Watershed (as based on ARC impervious quotients)

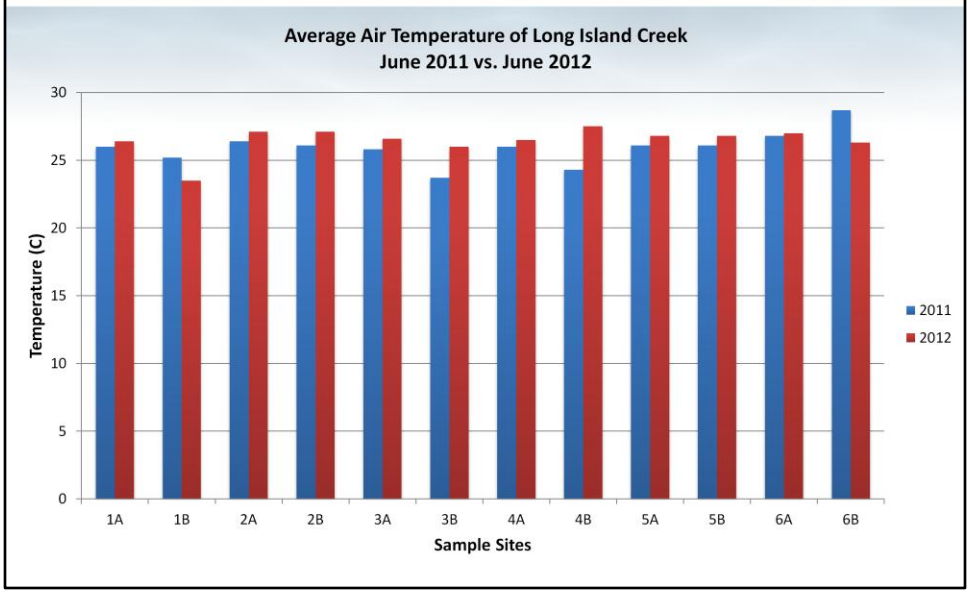
	Classes								TOTAL
Year	Major Roads	Commercial	Forest	Low Density Residential	Apartment/ Townhouse	Single Family Residential	Agriculture	Office/ Light Industrial	% impervious surface in watershed
2003	3.97	4.1	0.15	1.21	12.79	3.12	0.05	1.08	26.47
2005	4.81	4.3	0.13	0.95	7.05	5.96	0.05	0.79	24.04
2006	4.96	2.84	0.14	1.86	6.72	5.67	0.04	0.74	22.97
2008	4.86	2.33	0.7	1.49	13.97	4.07	0.09	0.31	27.19
2009	7.65	13.61	0.13	4.22	4.03	2.53	0.04	3.99	36.2
2011	2.55	2.97	0.15	2.0	6.77	5.48	0.5	0.73	22.7

Jeffrey Oparnica

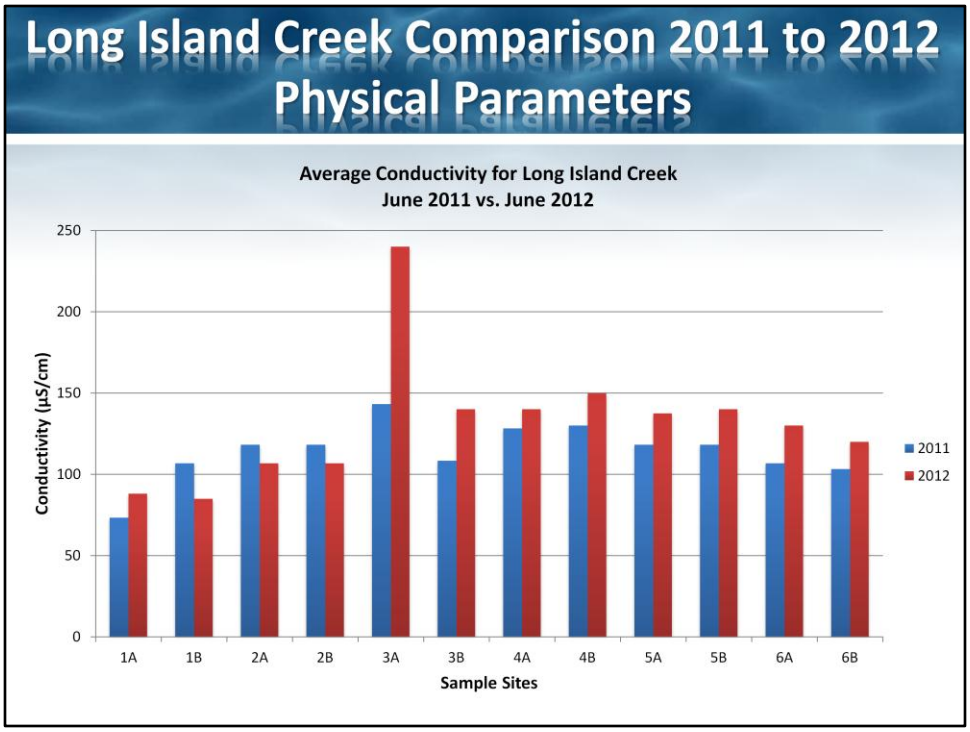


Logan Marshall

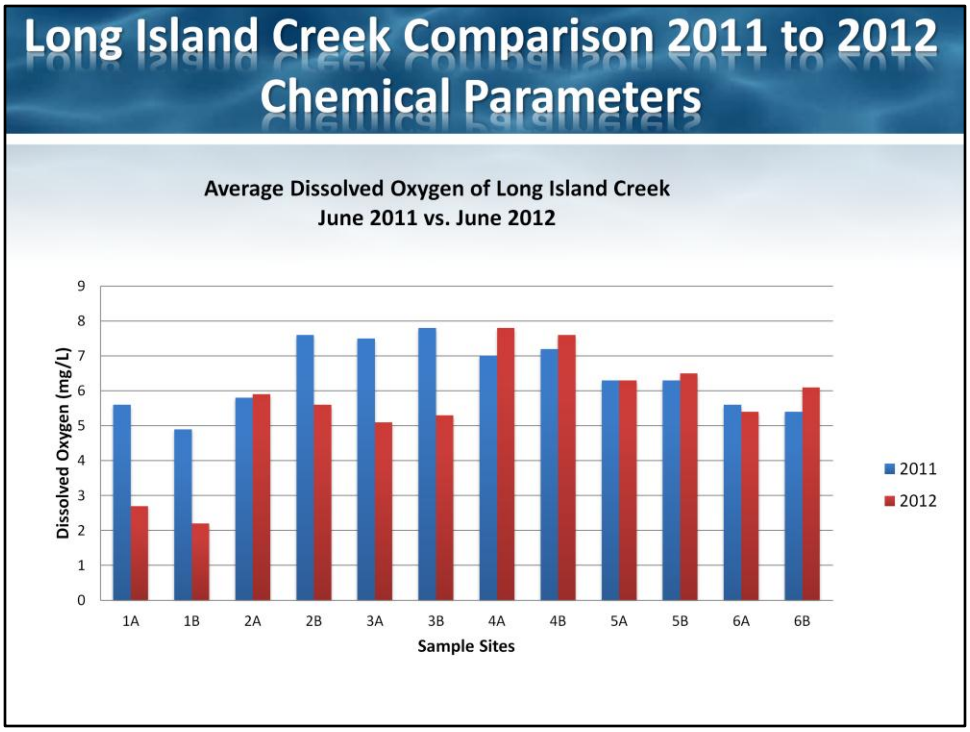
Long Island Creek Comparison 2011 to 2012 Physical Parameters



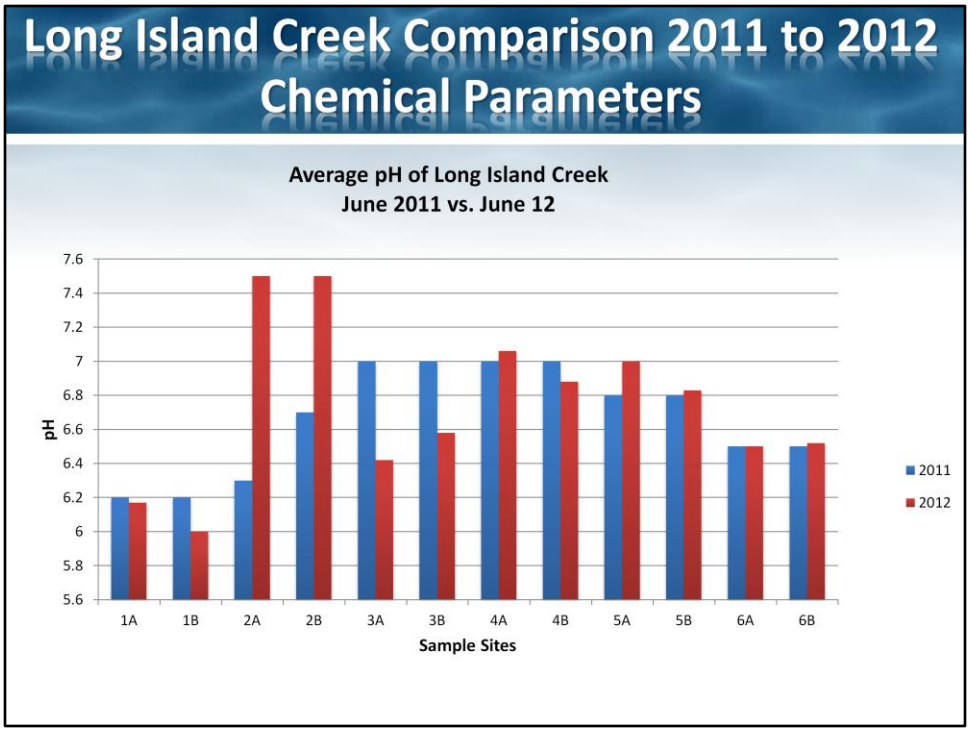
Logan Marshall



Logan Marshall



Logan Marshall



Logan Marshall

Long Island Creek Comparison 2011 to 2012 Chemical Parameters

2011

	Nitrate (mg/L)			Phosphate (mg/L)		
Sites*	max	min	average	max	min	average
1A*	0.25	0.05	*0.18*	<1	<1	*<1*
1B*	1.5	0.05	*0.68*	<1	<1	*<1*
2A	2	0	*0.63*	<1	<1	*<1*
2B	2	0	*0.88*	<1	<1	*<1*
3A	1	0	*0.5*	<1	<1	*<1*
3B	0.25	0	*0.13*	<1	<1	*<1*
4A	0.25	0.25	*0.25*	3	1	*2*
4B	0.25	0.25	*0.25*	2	<1	*<1 - 2*
5A	0.25	0	*0.13*	<1	0	*<1*
5B	0.25	0	*0.13*	<1	0	*<1*
6A	0.25	0	*0.13*	<1	0	*<1*
6B	0.25	0	*0.13*	<1	0	*<1*

*n = 6 collected over 3 days; all other are n =4 collected over 2 days

2012

	Nitrate (mg/L)			Phosphate (mg/L)		
Sites*	max	min	average	max	min	average
1A	0	0	*0*	0	0	*0*
1B	0	0	*0*	0	0	*0*
2A	1	0	*<1*	0	0	*0*
2B	0	0	*0*	0	0	*0*
3A	0	0	*0*	0	0	*0*
3B	0	0	*0*	0	0	*0*
4A*	0	0	*0*	0	0	*0*
4B*	0	0	*0*	0	0	*0*
5A	0	0	*0*	0	0	*0*
5B	0	0	*0*	0	0	*0*
6A	0	0	*0*	0	0	*0*
6B	0	0	*0*	0	0	*0*

*n = 8 collected over 4 days; all other are n =6 collected over 3 days

Logan Marshall

Long Island Creek Comparison 2011 to 2012
E.coli Results

2011

Sites	*E. coli* (cfu/100mL) 7-Jun-11	9-Jun-11	21-Jun-11	23-Jun-11
1A	7333	-	TNTC	-
1B	900	-	2000	-
2A	-	633	4133	2850
2B	-	-	1733	2733
3A	1267	-	-	4900
3B	400	-	-	1200
4A	933	-	-	4200
4B	833	-	-	4166
5A	967	-	1500	-
5B	600	-	1133	-
6A	1467	-	1367	-
6B	-	0	2933	-

"-" = no sample taken

TNTC = Too Numerous To Count

Each result is an average of n=3

2012

Sites	*E. coli* (cfu/100mL) 14-Jun-11	19-Jun-11	26-Jun-11
1A	1433	1167	-
1B	1533	1133	533
2A	1100	933	1500
2B	1000	533	1300
3A	3500	1633	733
3B	600	267	67
4A	0	0	0
4B	0	0	0
5A	1100	300	367
5B	1267	300	533
6A	1467	700	700
6B	1000	667	267

"-" = no sample taken

TNTC = Too Numerous To Count

Each result is an average of n=3

Logan Marshall

Marsh Creek Conclusion

- Chemical and physical observations
- Invasive plants and high levels of biomass in the stream
- Red flags

Tad Hammer

Long Island Creek Conclusion

- Recreational evaluation
- Aquatic evaluation
- Stream impairment level

Jennifer Pramuk

Conclusion

- Urbanization impact on non-point source pollution
  - Complexities: Theory vs. Reality
  - Factors
  - Overall assessment

For information see our wikispace at:
https://watershed2012.wikispaces.com/Powerpoint

Tad Hammer

Conclusion

- Future:
  - More accurate testing methods
  - Fish study for every site
  - Improve remote sensing imagery
  - Studies conducted year round for both creeks

Jennifer Pramuk

Acknowledgements

- Sharon Smith
- Jason Ulseth
- Allyson Read
- Dr. Dick Farmer
- Patti Berkovitz
- Dr. Bill Ensign
- Jack White
- David Fountain
- Angela Parker
- Celia Klardie
- Michael Barnett
- Fred Merkle
- Mary Lanning
- Dr. Troy Mutchler

Questions?

Jennifer Pramuk